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Foreigner's Stocks Investment and Financial Markets Instability in East Asia during the 2007-2009 Global Financial Crisis*

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This paper investigates the question of whether the stability of financial markets is damaged by foreigner's stock investment by estimating its dynamic relationships with stock price and exchange rate in East Asia, focusing on the 2007-2009 global financial crisis. We find that the negative effects of foreigner's stock investment on stock price and exchange rate are much stronger during a crisis than in normal times in many East Asian countries. This finding suggests that foreigner's stock investment could act as a destabilizing factor in domestic financial markets, especially in the face of global financial disturbances. In particular, the Korean exchange market is found to be most vulnerable to the global shocks among East Asian countries.

As the impact of the global common shocks turns out to be very substantial in East Asian countries, policy makers should strengthen financial cooperation within this region. Increasing the intra-regional trades in stocks is expected to promote the financial stability in this region by providing opportunities for sharing investment risks among East Asian countries. In addition, regulatory measure such as the Tobin tax may be useful in limiting capital movements against a possible crisis.

Keywords: Foreigner's Stocks Investment, Financial Instability, Global Financial Crisis, Stock Prices, Exchange Rates, East Asia

1. INTRODUCTION

Capital liberalization has been expected to promote the development and stability of financial markets through expansion of investment funds, income smoothing, and cross-country diversification of risks (Obstfeld 1998; Stulz 1999; Mishkin 2006). However, critical views that capital liberalization does not help stabilize the financial markets have begun to emerge because the financial crises in emerging markets such as Asia, Latin America and Russia have not subsided in spite of the rapid progress of capital liberalization (Rodrik 1998; Bhagwati 1998; Krugman 1998; Stiglitz 2002; 2008). Especially, the problems of capital market globalization and loose financial regulations have been discussed widely, led by the G-20 in the aftermath of the 2007-2009 global financial crisis.

Recent global financial crisis highlights the importance of the international spillover of financial shocks. Galesi and Sgherri (2009) estimate the spillover effects of the financial shocks on 17 EU countries and 9 emerging economies in Europe using a global vector

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autoregressive model (GVAR). They find that stock price is a main channel of spreading financial shocks to other countries in the short run. This is caused by a strong coupling of countries' stock markets. Gyntelberg *et al.* (2009) also find large fluctuations of the Thai baht exchange rate in the reallocation process of foreigner's portfolio investments. In case of Korea, stock price plummeted, exchange rate soared, and the volatilities of these variables also increased sharply due to a sudden stop of capital during the 2007-2009 global financial crisis. Furthermore, negative wealth effects and economic uncertainty shrank consumption and investment and deteriorated the balance of payments, thereby raising the vulnerability to the financial crisis.

Taking the above situations into account, this paper empirically analyzes the effects of capital liberalization on financial markets instability, focusing on the period of the global financial crisis. In particular, this paper investigates whether the stability of financial markets is damaged by foreigner's stock investment by estimating its relationship with stock price and exchange rate. As mentioned before, stock investment has been pointed out as an important channel through which financial shocks spread across countries and financial markets. Furthermore, we focus on the period of financial crisis because there are dramatic differences in foreign investor's behaviors between crisis and normal times.

Many studies have analyzed the behavior of foreign investors in Korean stock market. Among others, Kim (1999) finds that foreigners make stock prices unstable by taking positive feedback investment strategies during the years of 1995-1998. Yun and Bae (2007) show that foreign investor's opinions as well as exchange rate, U.S. interest rate, and expected rate of return on stock are important factors to influence stock market during the years of 1998-2007. Min (2009) documents that the influences of traditional price variables such as domestic stock price and exchange rate have weakened, while those of psychological factors, global stock markets trends, and risk aversion tendencies have enlarged. He also finds that foreign investment funds act as disturbing factors in Korean financial markets by seeking short-term profits. These findings suggest that Korean stock market recently has become more vulnerable to external shocks as foreign investors respond more sensitively to even a small change in external conditions.

In contrast with the previous studies, this study includes four more East Asian countries other than Korea and updates the sample period to include the 2007-2009 financial crisis. By including more countries and updating the data, the paper intends to find disparities among those similar countries who suffered from the common shocks of the global financial crisis and to draw more useful policy implications. Focusing on the short-term effects, we use daily data from January 2002 to September 2009. We divide the whole period into two sub-periods: January 2002 – June 2007 and July 2007 – September 2009 to identify the short-term effects that appeared in the course of the recent global financial crisis.

The paper is organized as follows. In session II, we first perform a technical analysis to identify the characteristics of foreigner's net investment in stocks and volatilities of various financial variables. In session III, we estimate the dynamic relationships between foreigner's stock investments, stock prices, and exchange rates using VAR models. We consider many other explanatory variables, such as the rate of return to U.S. stock price and the CDS premium as investment environments-related variables; the TED spread as investor's sentiments for risky assets in the international financial markets; and the Citi macro risk index (MRI) as a proxy variable for global risk aversion. Session IV summarizes major findings and draws policy implications for stabilizing the financial markets.

2. TECHNICAL ANALYSIS

As the value of derivatives fell and investment losses expanded following the 2007 subprime crisis, asset management behaviors of international financial institutions changed sharply. International financial institutions deleveraged, preferred safe assets, and expanded investment in their own countries (Min 2009). As a result, developed countries' investment funds left emerging countries. Volatility of financial markets in emerging countries was magnified several times. Stock prices in emerging countries fell more than that of the United States where the crisis occurred and the CDS premiums in emerging countries went up greatly. During the global financial crisis, the rapid movements of foreign capitals undermined the financial market stability, and hence it is necessary to identify the characteristics of foreign capital movements to cope with financial risks.

Foreigner's stock investments in East Asia are characterized as follows. First, as we can see in Table 1, foreigner's stock investment in East Asia except Korea tended to rise until the first half of 2007. However, foreign investment funds begun to pull out East Asia in the second half of 2007 when the U.S. subprime mortgage crisis emerged.

Second, the correlation between foreigner's net sells of stocks in five East Asian countries except Indonesia had multiplied since July 2007 (Table 2). It resulted from the concurrent outflows of foreign capitals from the East Asian stock markets following the common global financial shocks. When the financial crisis occurs in an international financial center such as the United States, it quickly spreads worldwide. In this process, simultaneous capital outflows of foreign funds play a critical role in determining the strength of the spillover effects. In this respect, we need to pay more careful attention to the changes in the correlation of foreigner's stock investments between countries.

Third, volatility of foreigner's net buys of stocks as well as the percentage changes in stock prices and exchange rates have greatly increased during the global financial crisis. Figure 1 presents the conditional volatility of foreigner's net buys of stocks and percentage changes in stock price and exchange rate in Korea, estimated by an AR (1)-GARCH (1,1) model for the period of February 1, 2002 to September 30, 2009. It is easily seen that volatilities of all of the three variables are much larger in the post-crisis period than in the pre-crisis period.

Table 1. Foreigner's Net Buys of Stocks in East Asian Countries

(billion dollars)

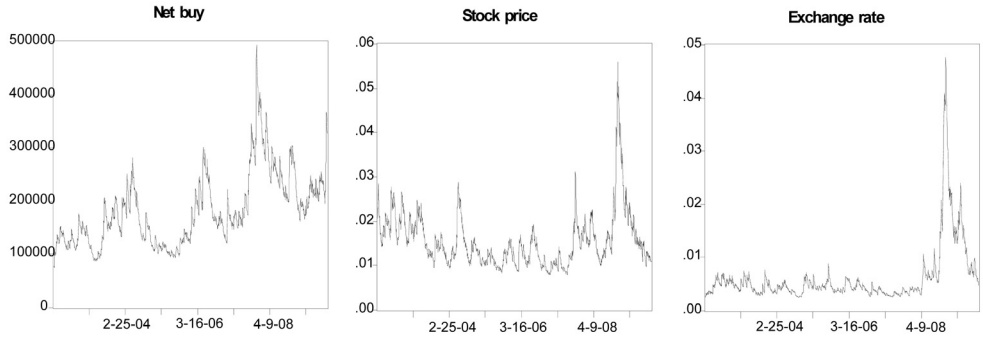
Countries	2002	2003	2004	2005	2006	2007		2008	
						1st half	2nd half	1st half	2nd half
Korea	22.1	117.4	88.5	-29.6	-113.4	-3.6	-263.1	-181.9	-141.0
Taiwan	7.2	159.6	93.6	222.1	174.2	78.6	-57.9	-28.4	-118.8
Thailand	2.8	-6.4	1.0	29.5	20.7	29.3	-13.8	-15.8	-32.7
Indonesia	8.7	11.7	21.1	-17.4	19.4	20.5	11.2	5.3	12.0
Philippines	-0.5	-0.8	2.8	3.5	7.2	14.5	-1.0	-4.0	-7.3

Source: Min (2009).

Table 2. Correlation Coefficients between Foreigner's Net Sells of Stocks in East Asian Countries

	2002. 1 – 2007. 6				
	Korea	Indonesia	Philippines	Taiwan	Thailand
Korea	1.0000				
Indonesia	0.4372	1.0000			
Philippines	0.0353	0.7331	1.0000		
Taiwan	0.3564	0.7983	0.8844	1.0000	
Thailand	-0.0520	0.5406	0.9022	0.8666	1.0000
	2007. 7 – 2009. 9				
	Korea	Indonesia	Philippines	Taiwan	Thailand
Korea	1.0000				
Indonesia	-0.7837	1.0000			
Philippines	0.9392	-0.8653	1.0000		
Taiwan	0.9153	-0.7896	0.9044	1.0000	
Thailand	0.9301	-0.8769	0.9462	0.9711	1.0000

Source: Bloomberg.



Source: Bloomberg.

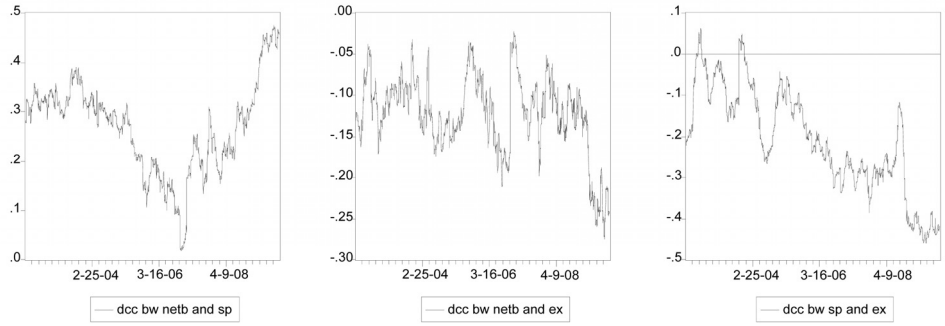
Figure 1. Conditional Volatility of Foreigner's Net Buys of Stocks, Stock Price, and Exchange Rate: Korea, February 1, 2002～September 30, 2009

Fourth, correlation of foreigner's net buys of stocks with percentage changes in stock prices, exchange rates, and the CDS premiums increased during the global financial crisis in most cases (Table 3). For example, in Korea the correlation coefficient of foreigner's net buys of stocks with percentage change in stock price rose from 0.2084 to 0.3038 after the 2007 financial crisis. During the same period, the correlation coefficient of foreigner's net buys of stocks with percentage change in the CDS premium increased sharply from -0.0788 to -0.2756.

Table 3. Correlation Coefficients of Foreigner's Net Buys of Stocks with Major Assets Prices

	2002.1 - 2007. 6			2007. 7 - 2009. 9		
	Stock price	Exchange rate	CDS premium	Stock price	Exchange rate	CDS premium
Korea	0.2084	-0.1201	-0.0788	0.3038	-0.1085	-0.2756
Indonesia	-0.0214	-0.0109	-0.0385	0.2457	-0.0282	-0.1059
Philippines	0.1313	-0.0812	-0.1358	0.1153	-0.0399	-0.0311
Taiwan	0.3511	-0.2242	-0.0276	0.5457	-0.2679	-0.0507
Thailand	0.4243	-0.1678	-0.1736	0.3742	-0.1933	-0.2518

Source: Bloomberg



Source: Bloomberg

Figure 2. Dynamic Correlation Coefficients: Korea, February 1, 2002～September 30, 2009

Figure 2 shows the dynamic correlation coefficients (DCC) between foreigner's net buys of stocks (netb) and percentage changes in stock price (sp) and exchange rate (ex) in Korea, estimated by a DCC-GARCH model. We can find that a positive correlation coefficient between foreigners net buys of stocks and percentage change in stock price significantly increased during the global financial crisis. A negative correlation coefficient between foreigners net buys of stocks and percentage change in exchange rate and between percentage changes in stock price and exchange rate also multiplied during the global financial crisis.

3. DYNAMIC RELATIONS BETWEEN FOREIGNER'S STOCK INVESTMENT, STOCK PRICE, AND EXCHANGE RATE

In this section, we empirically examine the dynamic effects of foreigner's stock investments on the prices of financial assets in East Asian countries. We employ a VAR model which was applied in Richards (2005), Yun and Bae (2007), Min (2009) and Poshakwale and Thapa (2009). In contrast with the previous studies, this study uses daily

data from January 2002 to September 2009. We divide the whole period into two sub-samples: January 2002 – June 2007 and July 2007 – September 2009 to identify the short-term effects of the recent global financial crisis. We consider Korea, Indonesia, Philippines, Taiwan, and Thailand where daily data of foreigner's stock investments are available.

Endogenous variables consist of variables of each country and variables related to the international financial markets. As for the variables of each country we include stock prices (SP), exchange rates (EX), the CDS premiums (CDS) for foreign exchange stabilization bonds, and foreigner's net buy ratios of stocks (NBR) in five East Asian countries. The foreigner's net buy ratio of stocks (NBR) is defined as:

$$NBR_t = (\text{foreigner's stock buys}_t - \text{sells}_t)/(\text{foreigner's stock buys}_t + \text{sells}_t). \quad (1)$$

We also include U.S. stock index (S&P 500) to represent the international financial markets, the TED spread[1] (TED) to capture the international liquidity conditions, and the Citi macro risk index (MRI) to reflect the global risk aversion. The VAR model is written as follow:

$$Y_t = A_0 + A_1 Y_{t-1} + \ldots + A_p Y_{t-p} + \varepsilon_t \quad (2)$$

Here, $Y_t = (\triangle TED_t, MRI_t, \triangle \ln SP500_t, \triangle \ln EX_t, \triangle \ln SP_t, \triangle CDS_t, NBR_t)$.

MRI index and NBR are I(0), but others are all I(1). For the I(1) variables, therefore we use their first differences. All stock prices and exchange rates are log-differenced, so they denote their percentage changes. We select time lags by AIC and order the 7 variables as is denoted in the parenthesis above. We apply the generalized impulse responses and variance decompositions developed by Pesaran and Shin (1998). A major limitation of the conventional VAR model is that the impulse responses and variance decompositions are sensitive to the ordering of variables in the model. Generalized impulse responses and variance decompositions overcome the problem of dependence of the estimation results on the ordering of the variables in the VAR.

The estimation results of impulse response functions for each country are summarized in Figures 3 to 7. In each figure, the first two rows are used to analyze the effects of the other 6 variables on foreigner's net buy ratios of stocks (NBR) and the third row is used to investigate the effects of NBR on exchange rate, stock price and the CDS premium of each country. Tables 4 to 8 present variance decompositions of NBR, exchange rate, stock price and the CDS premium of each country.

3.1. Korea

3.1.1. Effects on NBR

According to the impulse response functions in Figure 3(a), the stock prices of both the U.S. and Korea affect foreigner's net buy ratio of stocks (NBR) significantly at the 5% level before the global financial crisis. Increase in NBR is maximized on the second day after the stock prices of U.S. and Korea go up and these effects remain significant for five days. On the other hand, MRI and TED do not significantly affect NBR before the global financial

[1] TED spread is the difference between the 3 months euro LIBO and the 3 months T-bill rate, representing the degree of credit risks. As the TED spread increases, credit risks and interest rates rise, and liquidity shrinks, thereby prognosticating a fall of U.S. stock prices.

crisis. The CDS premium has a significant negative effect on NBR on the second day after the shocks arrive.

In the post-crisis period, the stock prices of the U.S. and Korea still significantly affect NBR as shown in Figure 3(b). In sharp contrast with the pre-crisis period, the won/dollar exchange rate, MRI, and TED also have significant negative effects on NBR during the crisis. In addition, the negative effect of the CDS premium on NBR is stronger during the crisis than before the crisis.

The results of variance decomposition are by and large consistent with those of the impulse response functions. Table 4(a) shows that the stock prices of the U.S. and Korea explain, respectively, about 16 and 12 percent of NBR's variances at 5-10 day intervals before the global financial crisis. On the other hand, the explanatory powers of TED, MRI, and exchange rate for NBR are negligible before the crisis. During the crisis, however, the explanatory power of MRI for NBR increases greatly, as shown in Table 4(b). The influences of TED and exchange rate on NBR are also magnified several times in the post-crisis period.

3.1.2. Effects of NBR

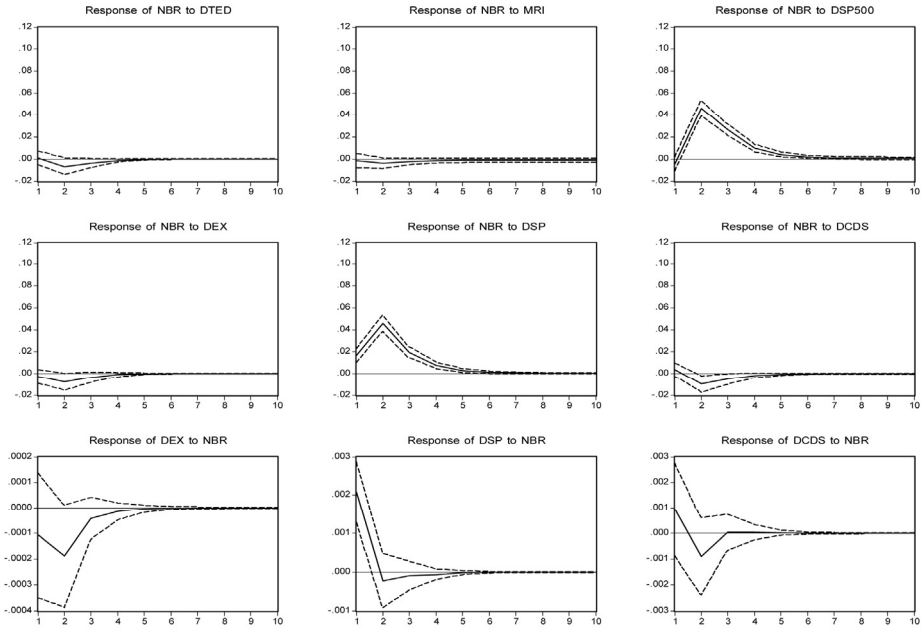
We now turn to the effects of NBR on exchange rate, stock price and the CDS premium of Korea. The third rows in Figure 3(a) and (b) show that NBR significantly decreases the won/dollar exchange rate for one day during the crisis,[2] while it does not significantly affect the won/dollar exchange rate before the financial crisis. According to the variance decomposition in Table 4, the influences of the other factors on the exchange rate are negligible before the crisis. However, the effect of the U.S. stock price increases greatly and explains about 20% of the variances of exchange rate during the crisis.

NBR has a significant positive effect on the Korean stock price for one day in both the pre and post crisis periods. However, its effect on the stock price increases from +0.002 before the crisis to +0.005 during the crisis (Figure 3). According to the variance decomposition in Table 4, the influence of the U.S. stock price on the Korean stock price increases slightly, but that of the exchange rate increases dramatically. The influences of NBR and TED on the Korean stock price also expand several times.

Before the global crisis, NBR does not significantly affect the CDS premium of Korea, but it significantly decreases the CDS premium for 2 days during the crisis (Figure 3). In the post-crisis period, the influences of all explanatory variables except for MRI on the CDS premium increase greatly, compared to the pre-crisis period (Table 4). It is noteworthy that the influences of TED and MRI increase overwhelmingly. These findings suggest that in crisis times, investor's sentiments for risky assets and global risk aversion in the international financial markets play a much more important role than in normal times.

[2] This result is consistent with Bank of Korea (2009). It points out that the stock price falls and the won/dollar exchange rate rises at the times of foreigners' net buying Korean stocks since September 2008.

(a) 2002. 1 - 2007. 6



(b) 2007. 7 - 2009. 9

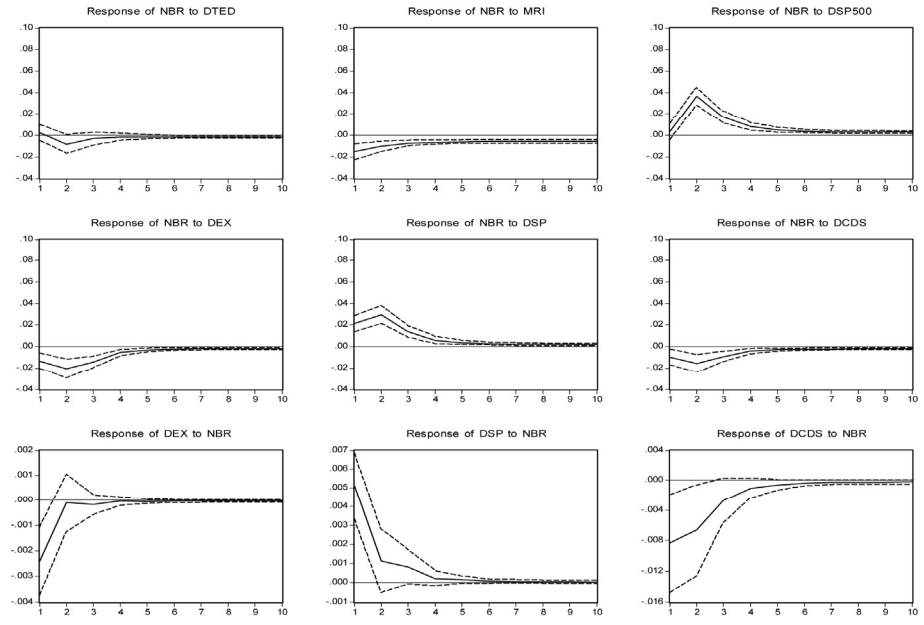


Figure 3. Impulse Response Function of Korea

Table 4. Variance Decomposition of Korea

(a) 2002. 1 - 2007. 6

Days	TED	MRI	SP500	Exchange rate	Stock price	CDS	NBR
				NBR			
1	0.0080	0.0145	0.1721	0.0668	2.5229	0.2581	96.9575
5	0.3422	0.1886	15.9346	0.4353	12.0620	0.1733	70.8640
10	0.3421	0.2154	15.9505	0.4351	12.0600	0.1733	70.8236
				Exchange rate			
1	0.6402	0.1786	0.0076	99.1736	0.0000	0.0000	0.0000
5	0.6876	0.2038	1.5149	96.8700	0.5476	0.0010	0.1750
10	0.6874	0.2221	1.5219	96.8444	0.5481	0.0011	0.1750
				Stock price			
1	0.0029	0.4306	1.1569	1.4079	97.0018	0.0000	0.0000
5	0.1273	0.4309	12.6169	1.3224	85.3767	0.1072	0.0187
10	0.1273	0.4575	12.6213	1.3219	85.3460	0.1073	0.0187
				CDS premium			
1	0.0001	1.5162	0.4498	3.2458	0.9166	93.8716	0.0000
5	0.0254	1.4597	2.4686	3.7386	2.6523	89.6472	0.0082
10	0.0254	1.4631	2.4695	3.7385	2.6522	89.6430	0.0082

(b) 2007. 7 - 2009. 9

Days	TED	MRI	SP500	Exchange rate	Stock price	CDS	NBR
				NBR			
1	0.0897	3.3589	0.2654	2.6480	3.8921	0.0318	89.7140
5	0.8815	4.5883	15.8730	2.5602	5.9893	0.0391	70.0686
10	0.9857	6.0788	15.9264	2.5191	5.8760	0.0405	68.5735
				Exchange rate			
1	0.5503	0.0565	20.8398	78.5534	0.0000	0.0000	0.0000
5	1.0067	0.0851	20.3616	77.6268	0.7333	0.0241	0.1625
10	1.0086	0.1127	20.3603	77.5983	0.7332	0.0241	0.1629
				Stock price			
1	1.2788	0.4599	10.0047	15.1182	73.1385	0.0000	0.0000
5	2.3145	0.4238	18.5798	13.3314	64.4885	0.3427	0.5192
10	2.3155	0.4438	18.5809	13.3277	64.4695	0.3427	0.5200
				CDS premium			
1	1.0782	1.5326	3.6602	9.2246	7.3083	77.1961	0.0000
5	2.5296	1.3549	12.3006	8.2482	6.3235	68.5999	0.6432
10	2.5310	1.3868	12.3048	8.2446	6.3209	68.5675	0.6443

3.2. Indonesia

3.2.1. Effects on NBR

According to the impulse response functions in Figure 4(a), the stock prices of the U.S. and Indonesia are the main factors that affect foreigner's net buy ratio of stocks (NBR) before the global financial crisis. NBR increases for three days when the Indonesian stock price goes up. Following the increase in the U.S. stock prices, NBR increases on the second and third day without being affected significantly on the 1st day. The other variables except for the stock prices of the U.S. and Indonesia do not have any significant effects on NBR before the crisis.

In the post-crisis period, the stock prices of the U.S. and Indonesia still exert significant effects on NBR. In addition, NBR decreases on the second day when the rupee/dollar exchange rate goes up. MRI and TED spread do not affect significantly NBR in the post-crisis period.

According to the variance decomposition in Table 4(a), the stock prices of the U.S. and Indonesia explain relatively large proportions of NBR's variance, but the explanatory powers of TED, MRI, and exchange rate for NBR are negligible before the crisis. During the crisis, the explanatory power of the U.S. stock price remains the same, but that of the Indonesian stock price decline greatly. Compared to the pre-crisis period, the influences of the TED spread and MRI increase during the crisis, reflecting the instability in the international financial markets.

3.2.1. Effects of NBR

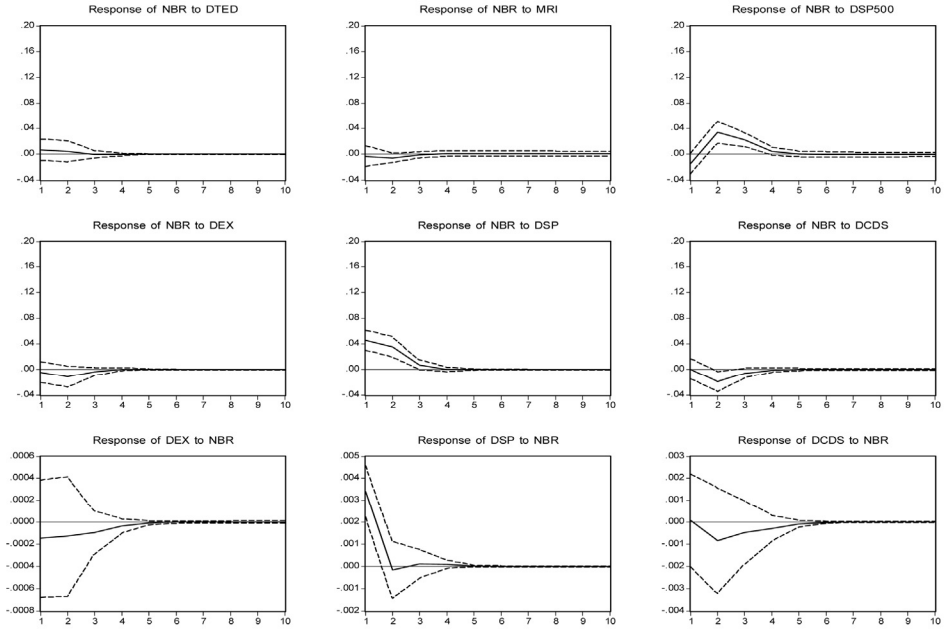
The impulse response functions in the third rows in Figure 4(a) reveal that before the global financial crisis, NBR affects only the Indonesian stock price significantly by on the first day. The rupee/dollar exchange rate and the CDS premium are not affected significantly by NBR. During the crisis, however, the effect of NBR on the Indonesian stock price increases from +0.003 to +0.005 on the first day and its significant effects last for two days in Figure 4(b). The rupee/dollar exchange rate and the CDS premium are not still affected significantly by NBR during the global financial crisis.

According to the variance decomposition in Table 5, the influences of the other factors except the U.S. stock price on exchange rate are insignificant before the global financial crisis. In the post-crisis period, the influences of the U.S. stock price on exchange rate increases greatly. The influences of TED and the Indonesian stock price on exchange rate also increase during the crisis, compared to the period before the crisis.

The explanatory powers of the U.S. stock price and the rupee/dollar exchange rate for the Indonesian stock price are high before the crisis. During the crisis, the influence of the rupee/dollar exchange rate decreases sharply from 15% to 4%, while the influences of NBR and other variables related to the international financial markets such as the U.S. stock price, TED and CDS increase greatly.

The explanatory power of the U.S. stock price on the CDS premium is high before the crisis, but it decreases from 23% to 16% in the post-crisis period. In contrast, the explanatory powers of TED and the Indonesian stock price for the CDS premium greatly increase in the post-crisis period.

(a) 2002. 1 - 2007. 6



(b) 2007. 7 - 2009. 9

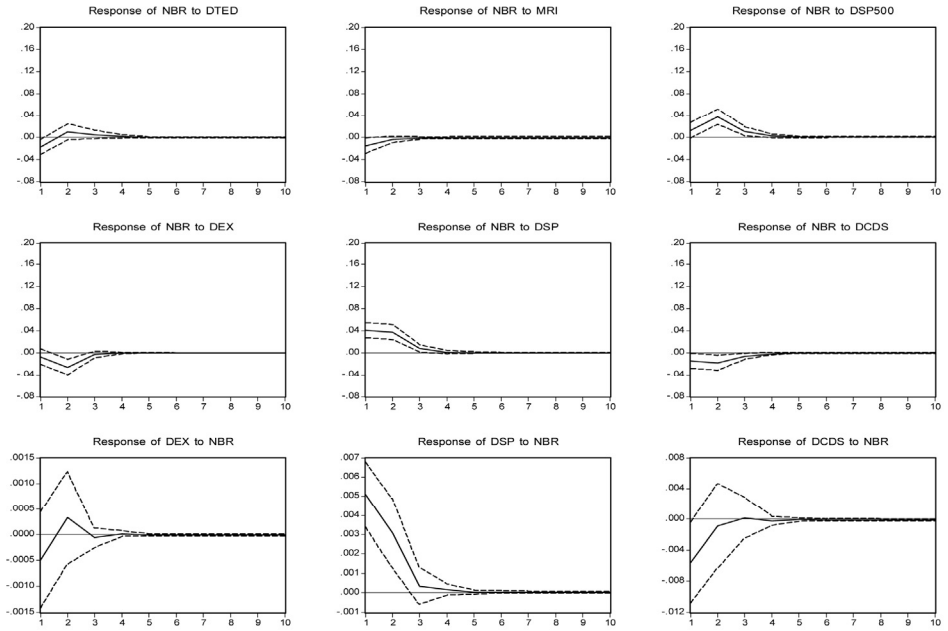


Figure 4. Impulse Response Function of Indonesia

Table 5. Variance Decomposition of Indonesia

(a) 2002. 1 - 2007. 6

Days	TED	MRI	SP500	Exchange rate	Stock price	CDS	NBR
				NBR			
1	0.1852	0.0327	0.8879	0.1058	9.8713	0.2178	88.6993
5	0.2251	0.1508	6.5634	0.4080	12.5583	0.5163	79.5780
10	0.2252	0.1633	6.5694	0.4079	12.5558	0.5163	79.5619
				Exchange rate			
1	0.0000	0.7991	0.2824	98.9185	0.0000	0.0000	0.0000
5	0.2166	0.7562	7.8456	90.0272	0.0606	0.7864	0.3074
10	0.2168	0.7905	7.8650	89.9731	0.0606	0.7865	0.3075
				Stock price			
1	0.0126	1.1059	0.0643	18.1156	80.7017	0.0000	0.0000
5	0.1321	0.9859	16.1897	15.1776	67.4406	0.0013	0.0728
10	0.1322	0.9992	16.1948	15.1741	67.4252	0.0016	0.0729
				CDS premium			
1	0.2360	1.6200	1.0742	1.2687	2.2628	93.5384	0.0000
5	0.2694	1.4223	23.1803	2.4057	3.0058	69.3553	0.3612
10	0.2695	1.4350	23.1831	2.4053	3.0052	69.3408	0.3612

(b) 2007. 7 - 2009. 9

Days	TED	MRI	SP500	Exchange rate	Stock price	CDS	NBR
				NBR			
1	1.3018	1.1201	0.3693	0.0394	6.3835	0.0273	90.7586
5	1.5839	1.0462	7.0415	0.6916	8.3102	0.0452	81.2814
10	1.5842	1.0569	7.0424	0.6915	8.3091	0.0454	81.2705
				Exchange rate			
1	0.3954	0.0003	13.1358	86.4685	0.0000	0.0000	0.0000
5	0.4358	0.0120	12.7090	85.8684	0.4214	0.3271	0.2263
10	0.4366	0.0274	12.7095	85.8517	0.4214	0.3272	0.2262
				Stock price			
1	0.5858	0.0736	6.2821	4.2355	88.8230	0.0000	0.0000
5	2.8220	0.1469	17.6518	3.6766	74.8289	0.0262	0.8475
10	2.8230	0.2083	17.6495	3.6739	74.7716	0.0269	0.8469
				CDS premium			
1	0.4826	0.6305	5.5537	0.4648	10.3456	82.5229	0.0000
5	4.1829	0.5394	16.0992	1.9907	8.7113	68.2965	0.1801
10	4.1831	0.5737	16.0992	1.9899	8.7075	68.2665	0.1800

3.3. Philippines

3.3.1. Effects on NBR

The stock prices of the Philippines and the U.S. affect significantly foreigner's net buy ratio of stocks (NBR) before the global financial crisis, as shown in Figure 5(a). NBR increases significantly for five days following an increase in the Philippines stock price. Following an increase in the U.S. stock prices, NBR significantly increases for 4 days with the exception of the first day. The CDS premium has a significant negative effect on NBR for four to five days. On the other hands, the effects of TED and MRI on NBR are not significant.

Figure 5(b) suggests that during the crisis, the dynamic patterns of NBR in response to variables do not change fundamentally. The stock prices of the U.S. and the Philippines and the CDS premium still exert significant influences on NBR, but the other variables do not have any significant effects on NBR.

According to the variance decomposition in Table 6(a) and (b), the stock prices of the Philippines and the U.S. explain large proportions of variance of NBR relatively to the other variables before the financial crisis. During the crisis, the influences of the U.S. stock price somewhat increases, but those of the Philippines stock price decreases. Compared to the pre-crisis period, the influence of exchange rate on NBR decreases, but that of TED increases in the post-crisis period, reflecting the tendency for risk aversion in the international financial markets.

3.3.2. Effects of NBR

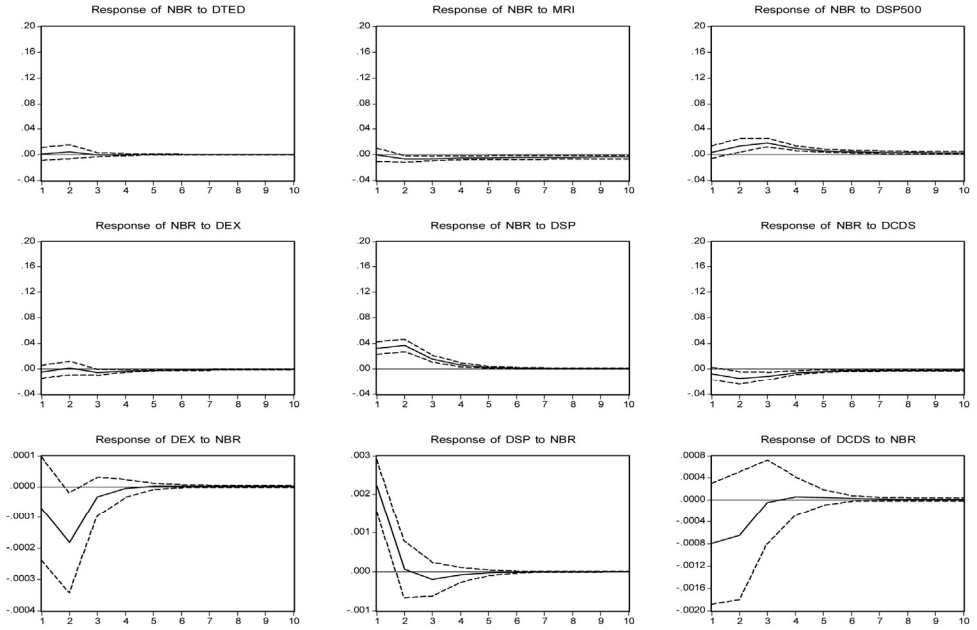
Before the financial crisis, NBR increases significantly the stock price of the Philippines for one day, but the peso/dollar exchange rate and the CDS premium are not affected significantly by NBR (Figure 5). During the financial crisis, the effects of NBR on the stock price increase from +0.0015 to +0.003. However, the peso/dollar exchange rate and the CDS premium are not affected significantly by NBR still in the post-crisis period.

According to Table 6, the explanatory powers of the other factors for the peso/dollar exchange rate are negligible before the financial crisis. During the crisis, however, the effects of the U.S. stock price on the peso/dollar exchange rate increases greatly, explaining 11% of the variance of exchange rate fluctuations, compared to 3% before the crisis. The effects of TED on the peso/dollar exchange rate increase during the crisis.

The Philippines stock price is largely explained by the U.S. stock price before the crisis, and this effect of the U.S. stock price more than doubles during the crisis. The explanatory power of the TED spread for the Philippines stock price also greatly increases during the crisis.

The influences of the U.S. stock price and the peso/dollar exchange on the CDS premium are high before the crisis. During the crisis, the effect of the U.S. stock price and the TED spread on the CDS premium sharply increases, but the effects of MRI, the peso/dollar exchange rate, and the Philippines stock price decrease.

(a) 2002. 1 - 2007. 6



(b) 2007. 7 - 2009. 9

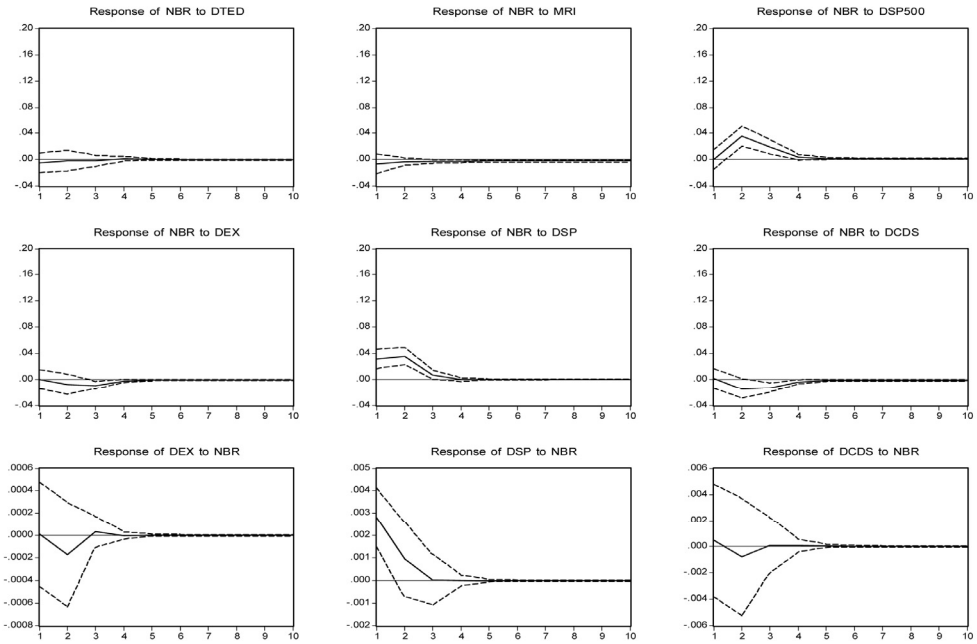


Figure 5. Impulse Response Function of the Philippines

Table 6. Variance Decomposition of the Philippines

(a) 2002. 1 - 2007. 6

Days	TED	MRI	SP500	Exchange rate	Stock price	CDS	NBR
				NBR			
1	0.0062	0.0000	0.0552	0.0589	4.0946	0.0008	95.7843
5	0.0657	0.4695	2.1487	0.1207	8.2320	0.3018	88.6615
10	0.0655	0.7416	2.2947	0.1214	8.2005	0.3100	88.2664
				Exchange rate			
1	0.0284	0.3383	2.0034	97.6299	0.0000	0.0000	0.0000
5	0.6075	0.3548	3.3144	93.6965	0.4334	1.3071	0.2862
10	0.6072	0.3886	3.3279	93.6495	0.4335	1.3072	0.2861
				Stock price			
1	0.0129	0.9412	0.6889	0.8706	97.4864	0.0000	0.0000
5	0.0668	0.9798	16.4273	1.1064	79.6243	1.7115	0.0839
10	0.0669	0.9798	16.4273	1.1064	79.6242	1.7115	0.0840
				CDS premium			
1	0.0125	3.0586	1.2752	3.8070	3.0707	88.7761	0.0000
5	0.0245	2.6393	15.0934	6.2853	2.9713	72.9738	0.0124
10	0.0245	2.6741	15.1015	6.2820	2.9701	72.9352	0.0126

(b) 2007. 7 - 2009. 9

Days	TED	MRI	SP500	Exchange rate	Stock price	CDS	NBR
				NBR			
1	0.0984	0.1737	0.0036	0.0033	3.7146	0.1762	95.8303
5	0.1198	0.2801	5.4217	0.0748	6.2814	0.2785	87.5438
10	0.1249	0.3735	5.4295	0.0763	6.2741	0.2813	87.4403
				Exchange rate			
1	0.9274	0.1954	7.2207	91.6565	0.0000	0.0000	0.0000
5	1.2755	0.2157	11.3147	86.6959	0.0555	0.3481	0.0946
10	1.2759	0.2244	11.3148	86.6862	0.0556	0.3484	0.0947
				Stock price			
1	1.0782	0.3786	3.3291	1.3120	93.9020	0.0000	0.0000
5	6.5274	0.2805	33.2356	1.0936	58.2388	0.4927	0.1313
10	6.5266	0.3166	33.2258	1.0937	58.2119	0.4937	0.1317
				CDS premium			
1	1.6218	1.0956	10.3607	3.5662	1.4136	81.9422	0.0000
5	2.7592	0.9589	20.0603	3.4354	1.3600	71.4108	0.0154
10	2.7592	0.9611	20.0601	3.4354	1.3600	71.4088	0.0154

3.4. Taiwan

3.4.1. Effects on NBR

The impulse response functions in Figure 6(a) exhibit that the stock prices of Taiwan and the U.S. and the Taiwan dollar/US dollar exchange rate affect significantly foreigner's net buy ratio of stocks (NBR) before the global financial crisis. The effects of the stock prices of Taiwan and the U.S. maximizes on the second day and last for five to six days after the stock prices of Taiwan and the U.S. rise. On the other hand, MRI and TED spread do not affect significantly NBR.

During the crisis period, the stock prices of Taiwan and the U.S. still exert significant positive effects on NBR. The impact effects of the stock price of Taiwan and the exchange rate on NBR double, respectively, from 0.04 to 0.08 and from -0.02 to -0.04 during the post-crisis period. In contrast to the pre-crisis period, TED and MRI have significant negative effects on NBR in the post-crisis period.

According to the variance decomposition in Table 7, the stock prices of the U.S. and Taiwan explain relatively large proportions of the variance of NBR, but the explanatory powers of the other variables are insignificant before the financial crisis. During the financial crisis the explanatory power of the U.S. stock price decreases, but that of the Taiwan stock price increases, compared the pre-crisis period. Compared to the previous period, the influences of the exchange rate, MRI, and TED on NBR increase sharply in the turmoil during the global financial crisis.

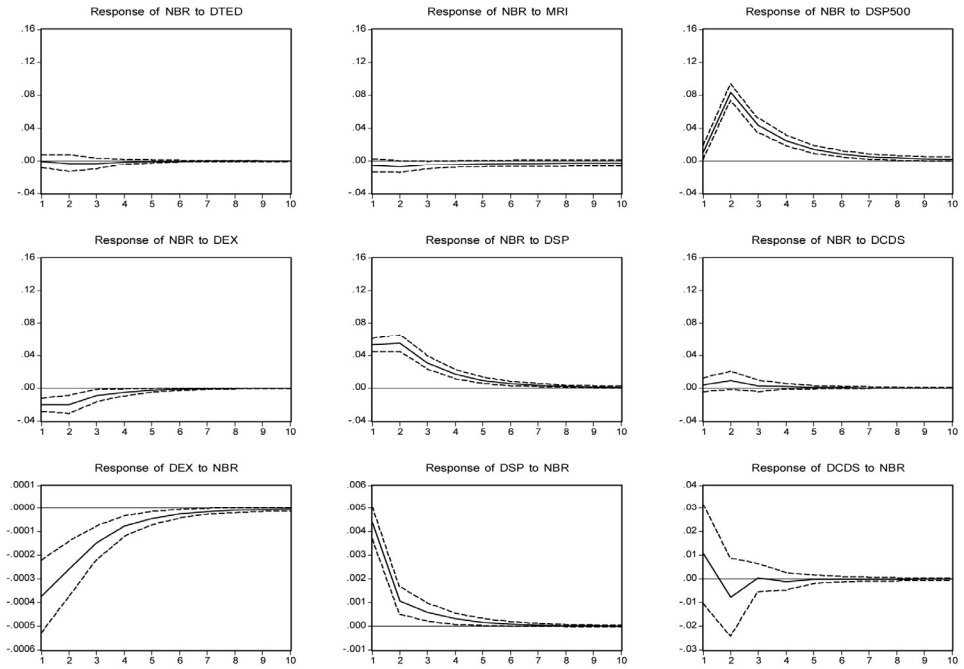
3.4.2. Effects of NBR

Before the financial crisis, NBR significantly increases the stock price of Taiwan, but decreases the Taiwan dollar/US dollar exchange rate for five to six days in Figure 6(a). During the financial crisis, NBR also has significant effects on the stock price and the exchange rate and its effects on the stock price and the exchange rate are doubled from 0.004 to 0.009 and from -0.0004 to -0.008, respectively, but the duration of its effects is shortened to two days in Figure 6(b). NBR does not have a significant effect on CDS before the crisis, but during the crisis it has significant negative effects on CDS for three days.

According to the variance decomposition in Table 7, the influences of the other factors on the exchange rate are negligible before the crisis. During the crisis, however, the effect of the U.S. stock price on the exchange rate increases highly, explaining 13% of the variance of the exchange rate. On the other hands, NBR explains a little of the variances of the stock price and the exchange rate in both periods.

The explanatory power of the U.S. stock price for the Taiwan stock price increases from 14% before the crisis to 18% during the crisis. The influences of TED and MRI on the stock price also increase greatly during the crisis. The influences of the other factors on CDS premium are negligible before the crisis, but those of TED and NBR highly increase during the crisis.

(a) 2002. 1 - 2007. 6



(b) 2007. 7 - 2009. 9

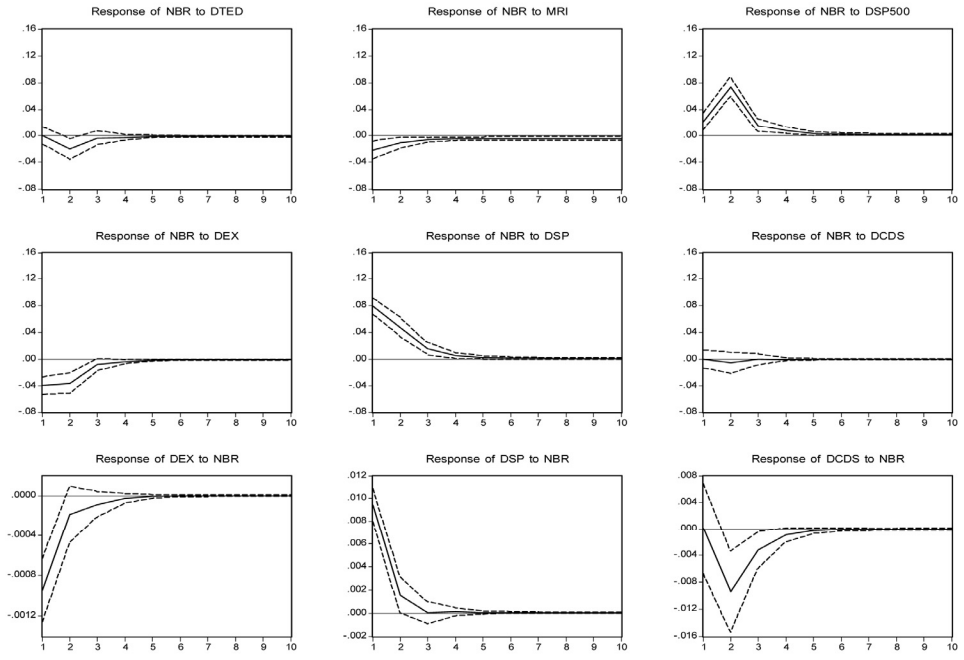


Figure 6. Impulse Response Function of Taiwan

Table 7. Variance Decomposition of Taiwan

(a) 2002. 1 - 2007. 6

Days	TED	MRI	SP500	Exchange rate	Stock price	CDS	NBR
				NBR			
1	0.0030	0.2006	0.6694	2.2838	13.3563	0.0753	83.4115
5	0.0666	0.4620	27.6862	2.2422	13.1515	0.1799	56.2116
10	0.0667	0.5746	27.8526	2.2328	13.1296	0.1799	55.9637
				Exchange rate			
1	0.2759	0.0196	0.0844	99.6201	0.0000	0.0000	0.0000
5	0.3158	0.0765	4.1766	93.1454	0.3058	0.9142	1.0658
10	0.3156	0.0944	4.2044	93.0893	0.3100	0.9137	1.0726
				Stock price			
1	0.0775	0.0097	2.5210	3.6799	93.7119	0.0000	0.0000
5	0.1289	0.0262	13.9241	3.5718	81.6534	0.0739	0.6216
10	0.1290	0.0279	13.9271	3.5717	81.6445	0.0740	0.6257
				CDS premium			
1	0.0104	0.0986	0.0681	0.0835	0.0538	99.6856	0.0000
5	0.0122	0.0936	0.4777	0.0811	0.0961	99.2378	0.0015
10	0.0122	0.0943	0.4783	0.0811	0.0961	99.2365	0.0016

(b) 2007. 7 - 2009. 9

Days	TED	MRI	SP500	Exchange rate	Stock price	CDS	NBR
				NBR			
1	0.0006	2.2817	2.3591	5.3035	23.0769	0.0298	66.9485
5	1.4688	2.4066	19.7370	4.0349	19.2596	0.0303	53.0628
10	1.4818	2.7232	19.7079	4.0188	19.1892	0.0306	52.8487
				Exchange rate			
1	0.2759	0.0080	13.4265	86.2896	0.0000	0.0000	0.0000
5	0.3055	0.0170	13.4495	85.6617	0.0411	0.0004	0.5248
10	0.3055	0.0170	13.4495	85.6616	0.0411	0.0004	0.5248
				Stock price			
1	0.2967	0.2880	6.6602	4.0587	88.6963	0.0000	0.0000
5	3.6754	0.2900	18.4043	3.4718	73.9487	0.0103	0.1995
10	3.6759	0.3144	18.4026	3.4708	73.9266	0.0103	0.1995
				CDS premium			
1	0.5594	0.0382	0.0702	0.0169	0.0727	99.2428	0.0000
5	0.6056	0.0866	0.5960	0.1527	0.6408	97.0407	0.8777
10	0.6061	0.0962	0.5976	0.1527	0.6410	97.0289	0.8776

3.5. Thailand

3.5.1. Effects on NBR

The impulse response functions in Figure 7(a) show that foreigner's net buy ratio of stocks (NBR) is affected significantly by the stock prices of Thailand and the U.S., the baht/dollar exchange rate, and MRI before the financial crisis. The stock prices of Thailand and the U.S have the largest effects on NBR on the second day and their effects remain significant for six days after stocks arrive. NBR significantly decreases for six days following an increase in the exchange rate of baht.

During the crisis, the dynamic effects of the stock prices of Thailand and the U.S., the baht/dollar exchange rate, and MRI on NBR are still significant and become a little bit stronger and longer lasting. In contrast to the pre-crisis period, TED and CDS exert significant negative effects on NBR in the post-crisis period.

According to the variance decomposition in Table 8, the stock prices of Thailand and the U.S. explain much larger proportions of the variance of NBR than the other variables before the financial crisis. During the crisis, the influence of the U.S. stock price on NBR increases, but that of the Thailand stock price decreases. The effect of the baht/US dollar exchange rate on NBR decreases, but the effects of TED, CDS, and MRI on NBR significantly increase, compared to the pre-crisis period.

3.5.2. Effects of NBR

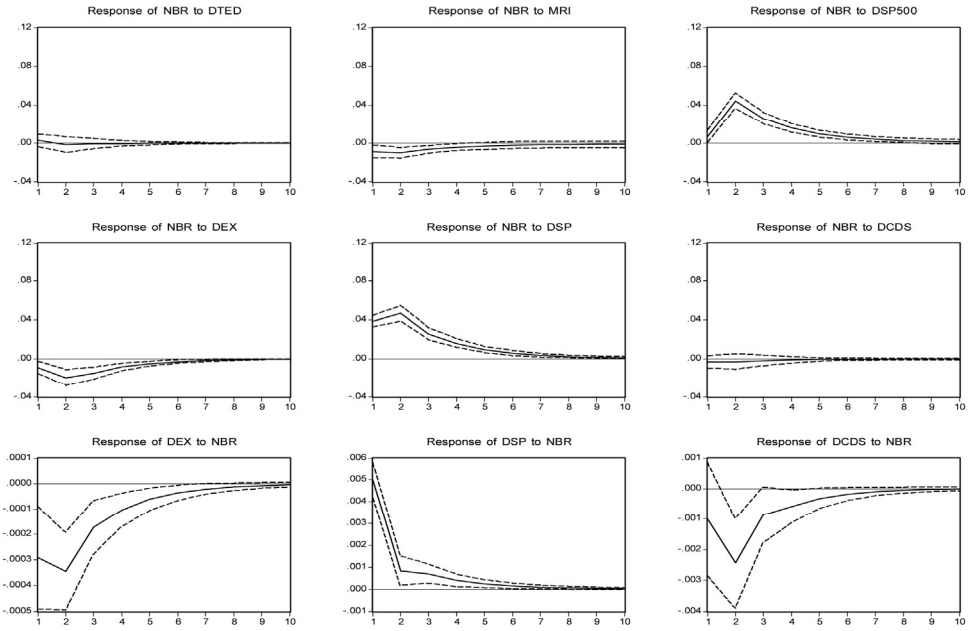
Following an increase in NBR, the baht/dollar exchange rate significantly falls for nine days before the crisis, as shown in Figure 7(a). The stock price of Thailand significantly rises for five to six days and the CDS premium falls significantly on the second day. During the financial crisis the effects of NBR on the stock price and the exchange rate still remain significant. In the post-crisis period, the effect of NBR on CDS multiplies greatly and remains significant for the first two days. The impulse response functions in Figures 3-7 suggest that the financial asset prices of Thailand are affected most intensively by NBR among five East Asian countries.

According to the variance decomposition in Table 8, the influences of the other variables on the exchange rate are insignificant before the crisis. In the post-crisis period, the influences of TED and CDS on the exchange rate increase relative to that of the pre-crisis period, while the influence of NBR does not change in a significant way.

The influences of the other variable on the stock price are not significant before the crisis. During the crisis, the explanatory power of the U.S. stock price for the stock price of Thailand greatly increases, but that of the exchange rate decreases. The influences of TED and NBR on the stock price increase significantly during the crisis.

In case of the CDS premium, the effects of Thailand and the U.S. stock prices are strong relative to those of the other variables before the crisis. During the crisis the effect of the U.S. stock price increases, explaining 13% of the variance of the CDS premium.

(a) 2002. 1 - 2007. 6



(b) 2007. 7 - 2009. 9

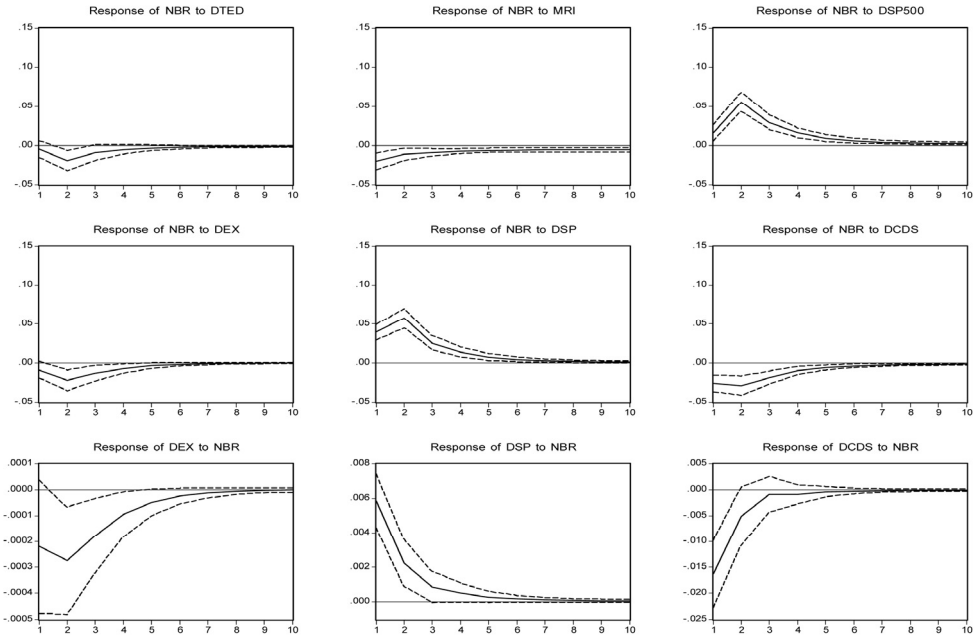


Figure 7. Impulse Response Function of Thailand

Table 8. Variance Decomposition of Thailand

(a) 2002. 1 - 2007. 6

Days	TED	MRI	SP500	Exchange rate	Stock price	CDS	NBR
				NBR			
1	0.0822	0.7041	0.4204	0.7563	13.6886	0.1734	84.1750
5	0.0583	1.2707	14.4760	3.4361	18.4186	0.3250	62.0153
10	0.0579	1.3327	14.6341	3.4650	18.4207	0.3238	61.7658
				Exchange rate			
1	0.0001	0.2189	0.0969	99.6841	0.0000	0.0000	0.0000
5	0.0597	0.2611	1.6687	96.4064	0.7876	0.0095	0.8070
10	0.0597	0.2615	1.6764	96.3805	0.7936	0.0096	0.8187
				Stock price			
1	0.0529	0.2359	1.0626	0.7010	97.9476	0.0000	0.0000
5	0.0733	0.3435	4.9018	3.4000	90.6326	0.0583	0.5905
10	0.0732	0.3548	4.9153	3.4005	90.5976	0.0583	0.6002
				CDS premium			
1	0.2711	0.8423	0.0870	0.1048	3.3110	95.3838	0.0000
5	0.2601	0.8108	4.2200	1.9283	3.3314	89.2216	0.2278
10	0.2601	0.8182	4.2203	1.9289	3.3326	89.2084	0.2316

(b) 2007. 7 - 2009. 9

Days	TED	MRI	SP500	Exchange rate	Stock price	CDS	NBR
				NBR			
1	0.1834	3.0834	1.7888	0.3255	8.7952	1.8184	84.0052
5	2.2377	3.0939	17.1231	1.8180	12.1233	1.8905	61.7135
10	2.2659	3.7138	17.2102	1.8040	12.0076	1.8977	61.1009
				Exchange rate			
1	0.0135	0.0881	1.4848	98.4136	0.0000	0.0000	0.0000
5	0.1823	0.1080	1.7777	96.8031	0.2122	0.0566	0.8601
10	0.1827	0.1081	1.7826	96.7897	0.2142	0.0571	0.8656
				Stock price			
1	0.6812	0.0099	13.0075	1.4095	84.8919	0.0000	0.0000
5	1.6183	0.1468	18.5149	1.4609	76.2411	1.0447	0.9733
10	1.6216	0.2217	18.5181	1.4596	76.1576	1.0459	0.9756
				CDS premium			
1	0.0901	0.5196	5.7085	0.0003	2.9510	90.7306	0.0000
5	0.8556	0.4816	13.2728	0.1574	2.8657	82.0763	0.2907
10	0.8563	0.4918	13.2746	0.1574	2.8653	82.0634	0.2912

3.6. Comparison across Countries

Table 9 exhibits foreigner's net buy ratio of stocks (NBR) of each country. The average values of NBR for all countries are positive before the global financial crisis, but they turn into negative except Indonesia during the period of the financial crisis. The average value of NBR is the lowest in the Philippines (-0.0705), followed by Thailand (-0.0465), Taiwan (-0.0203) and Korea (-0.0171) during the financial crisis. The standard deviations of NBR in Korea, Indonesia, and Taiwan decrease, but those of the Philippines and Thailand increase in the post-crisis period. The persistence of NBR (AR(1) coefficient and half-life) in Korea and Indonesia increases during the global financial crisis.

Table 10 shows cross-country comparison of the impulse response functions about the effects of foreigner's net buy ratio of stocks (NBR) on exchange rate, stock price and CDS premium. Major findings are summarized as follows. First, NBR affects significantly the

Table 9. Cross-country comparison of NBR

	Korea	Indonesia	Philippines	Taiwan	Thailand
2002. 1 - 2007. 6					
Average	0.0091	0.0645	0.0273	0.0583	0.0119
Median	-0.0009	0.0593	0.0276	0.0665	0.0191
Maximum	0.5065	1.0000	0.9175	0.8559	0.4490
Minimum	-0.4624	-0.9682	-0.8577	-0.6620	-0.5412
Standard error	0.1396	0.2307	0.1710	0.1985	0.1385
Skewness	0.3515	-0.1089	-0.6062	-0.1645	-0.1896
Kurtosis	3.7449	7.0600	8.8823	2.9781	3.2568
AR(1) coefficient	0.4241	0.2008	0.3921	0.5629	0.5697
Half-life	0.8081	0.4317	0.7404	1.2062	1.2319
Sample size	1,338	1,336	1,356	1,337	1,343
2007. 7 - 2009. 9					
Average	-0.0171	0.0294	-0.0705	-0.0203	-0.0465
Median	-0.0272	0.0247	-0.0721	-0.0286	-0.0360
Maximum	0.3045	0.8575	0.9882	0.5494	0.3794
Minimum	-0.2890	-0.5142	-0.8573	-0.5744	-0.6321
Standard error	0.1136	0.1680	0.1865	0.1806	0.1666
Skewness	0.3801	0.4195	1.0198	-0.0643	-0.2593
Kurtosis	2.7767	5.2552	10.1934	2.9149	2.9556
AR(1) coefficient	0.5562	0.2362	0.1873	0.43320	0.5631
Half-life	1.1816	0.4803	0.4138	0.8286	1.2069
Sample size	560	542	549	560	552

Table 10. Cross-country comparison of impulse response functions

(a) Effects of NBR on exchange rates

	2002.1 - 2007.6			2007.7 - 2009.9		
	Size	Significance	Periods	Size	Significance	Periods
Korea	-0.0002	X	-	-0.0021	O	1 day
Indonesia	-0.0017	X	-	-0.0005	X	-
Philippines	-0.0002	X	-	-0.0002	X	-
Taiwan	-0.0004	O	1-6 days	-0.0008	O	1 day
Thailand	-0.00035	O	1-6 days	-0.0003	O	2-3 days

(b) Effects of NBR on stock prices

	2002.1 - 2007.6			2007.7 - 2009.9		
	Size	Significance	Periods	Size	Significance	Periods
Korea	0.002	O	1 day	0.005	O	1 day
Indonesia	0.003	O	1 day	0.005	O	1-2 days
Philippines	0.002	O	1 day	0.0025	O	1 day
Taiwan	0.004	O	1-4 days	0.0085	O	1 day
Thailand	0.005	O	1-4 days	0.006	O	1-2 days

(c) Effects of NBR on CDS premia

	2002.1 - 2007.6			2007.7 - 2009.9		
	Size	Significance	Periods	Size	Significance	Periods
Korea	-0.001	X	-	-0.008	O	2 days
Indonesia	-0.001	X	-	-0.005	X	-
Philippines	-0.0008	X	-	-0.0008	X	-
Taiwan	-0.010	X	-	-0.008	X	-
Thailand	-0.0025	O	2 days	-0.022	O	1day

Note: X (O) indicates that the effect is statistically insignificant (significant) at the 5% level.

stock prices of all five countries before and after the 2007 global financial crisis, but the effects are much stronger in the post-crisis period than in the pre-crisis period. These results suggest that in crisis times, foreigner's stocks investment plays a very important role in strengthening the spillovers of the international financial shocks to the domestic financial markets, thereby raising the risks of the financial instability and crisis.

Second, Korea is the country that is the most influenced by NBR during the global financial crisis. Only Korean stock prices are affected significantly by NBR before the crisis, but the exchange rate, the stock price and the CDS premium are significantly affected by NBR during the crisis. In particular, the effects of NBR on the exchange rate and the CDS premium multiply 10 to 8 times during the crisis. The responses of the exchange rate to NBR

in Korea are overwhelmingly larger than in the other Asian countries. Therefore, Korea should design policy instruments leaning against the negative effects of foreigner's stock investment on the Korean foreign exchange market in preparation for a possible international financial crisis.

Third, Thailand is the most vulnerable country to shocks to NBR because the exchange rate, the stock price and the CDS premium are all significantly affected by NBR both before and during the global financial crisis. The effects of NBR on the CDS premium particularly increase in the post-crisis period. In contrast, in Taiwan the effects of NBR on the stock price and the exchange rate increase in two times, but that on the CDS premium decreases slightly after the 2007 financial crisis.

Fourth, the exchange rates and the CDS premia of Indonesia and the Philippines are not affected significantly affected by NBR both in the pre- and post-crisis periods. These results seem to be due to the fact that liberalization of their capital markets are happening at a slower pace and the scales of foreigner's stock investments are smaller than in the other countries. Recalling that both the exchange rate and the CDS premium skyrocketed during the financial crisis in Korea, we can draw lessons from the cases of the Philippines and Indonesia whose foreign exchange markets are not significantly disturbed by foreigner's stocks investment.

4. CONCLUSIONS

Foreigner's portfolio, particularly stocks investment is one of the most important channels through which the 2007 financial shocks spilled over worldwide. Foreigner's stock investment plays a more important role than foreigner's bonds investment in spite of the rapid development of the bonds market in the late 1990s in East Asia. Therefore, the short-term dynamic interactions between foreigner's stocks investment, stock price, and exchange rate are a key in investigating the possible negative effects of capital mobility on the stability in stock and currency markets.

This study estimates the dynamic relationships between foreigner's stock investments, stock prices, and exchange rates using VAR models in East Asia, focusing on the 2007-2009 global financial crisis. The findings of this study suggest that foreigner's stock investment could act as a destabilizing factor in domestic financial markets, especially in the face of global financial disturbances. When policy makers design financial and macro-economic policies, therefore, they should keep in mind that the negative effects of foreigner's stock investment on stock price, exchange rate, and CDS premium are much stronger in the crisis than in normal times. In particular, regulatory measures such as the Tobin tax may be useful in limiting capital movements against a possible crisis.

Korean exchange market is found to be most vulnerable to global shocks among East Asian countries during the 2007-2009 global financial crisis. This may be due to the small size of the foreign exchange market and the lack of the internationalization of the Korean won, along with the high degree of openness in the stock market. In this respect, we need policy instruments to encourage national banks and sovereign wealth funds to participate more actively in the foreign exchange. In addition, a wide variety of domestic investors can serve to protect domestic capital markets from abrupt changes in foreign investor's sentiments and global risk aversion. Different views of various groups may keep market sentiments from flowing in one direction unilaterally. In particular, pension and mutual funds

and institutional investors such as insurance sectors could contribute to stabilizing the domestic capital markets.

The findings of this study point out that foreigner's stocks investment increases the financial market instability in most of East Asian countries in the course of the global financial crisis. As the impacts of the global common shocks turn out to be very large in the East Asian countries, policy makers should strengthen financial cooperation within this region. Increasing the intra-regional trades in stocks is expected to promote the financial stability in this region by providing opportunities for sharing the investment risks among East Asian countries.

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